PERANCANGAN PENGENDALI *HYBRID SLIDING MODE CONTROL* (SMC) DAN *PROPORTIONAL, INTEGRAL, DERIVATIVE* (PID) PADA SISTEM *ROTARY INVERTED PENDULUM*

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ABSTRAK

Sistem *rotary inverted pendulum* merupakan salah satu sistem dinamis dan *non linear* serta memiliki karakter yang sangat tidak stabil sehingga, untuk mengendalikannya dibutuhkan teknik kendali yang tidak mudah. Untuk mengatasi permasalahan kestabilan tersebut, maka pada penelitian ini menggunakan metode pengendali *hybrid* SMC-PID untuk mekanisme kendali yang mengatur permasalahan stabilisasi. Pengendali SMC merupakan pengendali yang mampu bekerja dengan baik pada sistem yang *non linear* dan kokoh terhadap gangguan serta memiliki respon yang cepat dalam mencapai kestabilan. Namun pengendali ini masih memiliki kekurangan yaitu *overshoot* dan *chattering* (osilasi) pada respon *steady state*. Untuk mengatasi kekurangan tersebut, pengendali SMC dikombinasikan dengan pengendali PID. Karena pengendali PID dapat mengatasi kekurangan yang ada pada pengendali SMC. Pada penelitian ini, pengendali *hybrid* SMC-PID mampu mempertahankan kestabilan batang pendulum dan kokoh terhadap gangguan serta menghilangkan *overshoot* dan *chattering* (osilasi). Dari pengujian yang dilakukan, didapatkan hasil analisa respon sistem dengan *error steady state* 0 rad, konstanta waktu 0.0405 detik, *rise time* 0.1192 detik, *settling time* 0.0810 detik, *delay time* 0.1006 detik, dan *overshoot* 0%.

Kata Kunci : *Chattering, Rotary Inverted Pendulum*, MATLAB, Pengendali *Hybrid* SMC-PID, Pengendali SMC, Pengendali PID.

DESIGNE OF HYBRID SLIDING MODE CONTROL (SMC) CONTROLLER AND PROPORTIONAL, INTEGRAL, DERIVATIVE (PID) CONTROLLER ON ROTARY INVERTED PENDULUM SYSTEM

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ABSTRACT

Rotary inverted pendulum system is one of the dynamic and non linear systems as well as having a character that is very unstable and to control it needed a control technique is not easy. To overcome the problems of stability, on this research using the method of hybrid controller SMC-PID control mechanism for regulating the problems of stabilization. SMC controller is a controller that is able to work well on a non linear systems and robust against interference and has a fast response in achieving stability. But it still has a shortage of controllers namely overshoot and chattering (oscillations) in response to steady state. To overcome these deficiencies, the SMC controller combined with PID controller. PID controller because it can overcome the existing deficiencies in SMC controller. In this study, SMC- PID hybrid controller was able to maintain the stability of the pendulum rod and robust against interference as well as eliminates overshoot and chattering (oscillations). From the testing that is performed, the system response analysis results obtained by error steady state is 0 rad, time constant is 0.0405 seconds, rise time is 0.1192 seconds, settling time is 0.0810 seconds, delay time is 0.1006 seconds, and overshoot is 0%.

Key Word: *Chattering, Rotary Inverted Pendulum, MATLAB, SMC-PID Hybrid Controller, SMC Controller, PID Controller*